

The 60<sup>th</sup> Annual Ohio Junior  
Science and Humanities  
Symposium



Capital University  
Ask. Think. Lead.

Columbus, Ohio • March 3, 2023



*Junior Science and Humanities Symposium (JSHS) is a Department of Defense sponsored STEM program (U.S. Office of the Secretary of Defense and the U.S. Departments of the Army, Navy, and Air Force).*

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**WELCOME FROM CAPITAL UNIVERSITY'S PROVOST**

It is my privilege to welcome you to the 60th Ohio Junior Science and Humanities Symposium!

Funding for JSHS is provided by the U.S. Army Research Office, U.S. Office of Naval Research, and U.S. Air Force Research Office. Through 48 regional symposia, JSHS brings together students throughout the United States, Puerto Rico, and DOD Schools in Europe and the Pacific.

Today's event showcases some of Ohio's most talented science, technology, engineering, and mathematics students to celebrate the work that they have accomplished. Through their research projects the student presenters demonstrate the skills and knowledge that they have gained inside and outside of the high school classroom. Two student finalists and three delegates from each regional JSHS program will be chosen to attend the National JSHS, which will be held April 12-15, 2023 in Virginia Beach, Virginia.

The presentations that you will see today are the result of hours of student work under the guidance of dedicated mentors. I offer a warm word of thanks to the teachers, scientists, and family members who have mentored these talented students. Your work with these students demonstrates the opportunities available to those who pursue careers in science, technology, engineering, and mathematics. Your willingness to nurture the interests of young scientists, engineers, and mathematicians is greatly appreciated.

Congratulations to each student presenter for your hard work and success.

Sincerely,  
Jody S. Fournier  
Capital University Provost

**WELCOME FROM THE OHIO JSHS DIRECTOR**

I am proud to welcome you to Capital University for the 60th Ohio Junior Science Humanities Symposium! Thank you for taking the time and making the effort in this challenging world to come together to support the state of Ohio's students who have worked tirelessly with mentors, teachers, and in the world of academics to bring us the levels of research studies that have great potential to impact our world for the better.

I am especially humbled that in this time of uncertainty, students and mentors have been perhaps even more motivated to follow their research pursuits, and we are thrilled to have the chance to celebrate these achievements. I hope each student feels valued and confident about their achievements and that mentors feel supported and find an abundance of collaboration and camaraderie with like-minded peers. Families, we also extend to you a personal welcome to our campus, encourage you to be comfortable here, and to feel free to continue making memories with your students that you already have brought so far.

The JSHS program was founded by Ohio native, Colonel George F. Leist. After the 1958 launch of the Russian satellite Sputnik, Colonel Leist initiated the Junior Science and Humanities Symposium for secondary school students. From the first Symposium in 1958, to the 60th in 2023, the Ohio Junior Science and Humanities Symposium continues to promote high standards and cutting-edge research, and to be a beneficial and educational experience. Now, more than ever, STEM education is critically important to our state, country, and planet. Thank you for joining us for this event!

Sincerely,  
Carmen Dixon  
Assistant Professor of Education

SCHEDULE OF EVENTS

8:30 am	Registration and Continental Breakfast	Capital Center Field House
9:30 am – 12:00 pm	Student Oral Presentations	Ruff Memorial Learning Center Classrooms
10:00 am	Optional Campus Tours	Depart from Capital Center Field House
12:00 pm	Lunch and Career Panel	Capital Center Field House
1:30 pm – 3:00 pm	Student Poster Session	Capital Center Field House
2:00 pm	Optional Campus Lab Tours and College Student Panel	Depart from Capital Center Field House
3:00 pm	Closing Session and Awards	Capital Center Field House

## CAREER PANEL

**Paul Chodak III, Executive Vice President – Generation**

Dr. Chodak is responsible for the management of AEP's nuclear, fossil, hydro and wind generating units, and Ohio Valley Electric Corp./Indiana-Kentucky Electric Corporation's (OVEC/IKEC) generating assets. This includes engineering, construction and operation of generating units, and activities related to fuel procurement and emission monitoring and logistics. The Cook Nuclear, Engineering, the Projects & Field Services, Fossil & Hydro Generation, Environmental Services, regulated Commercial Operations and regulated Generation Development groups report to him.

**Bob Moss, SEA Labs, Director, Chemical & Candle Laboratories**

Mr. Moss oversees and manages the daily operations of the SEA Corporate Laboratory. The Corporate Laboratory is responsible for conducting a variety of analyses, including fire debris analysis; environmental sample analysis for metals, organic hydrocarbons, and asbestos; flammable liquid and solvent analysis; automotive fluid analysis; automotive paint chip comparisons; wax composition analysis; fragrance concentration evaluations; product performance evaluations; coatings analysis; identification and characterization of small particles, including soot, natural

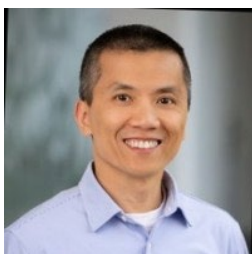
and synthetic fibers, plastics, polymers, and composites; contamination identification; and moisture analysis. In the past few years, he has focused on product failure analysis, specifically looking at customer returns in the candle industry and determining what happened and why.



**Know.**

**Sarala Pandey, Co-Founder of Step Ahead Tech, Director of IT Quality Assurance at Experis**

Sarala Pandey, an IT Quality Assurance Director, Trailblazer honoree of [Smart Business Woman](#) Columbus, and a great community social worker who serves the community she lives in. She is presently serving as a Director of Software Quality Assurance department at Experis. A co-founder of nonprofit organization named [Step Ahead Tech](#) and she is a board member of [ETSS](#). Sarala came to this country as an International Student, earned her undergraduate degree in Computer Science from Capital University 1998, she started her IT career as an intern at OCLC in 1997 then climbed the professional ladder all the way up to QA Director.

**Thanh Ta, Scientist, Global Flavor Technology, Abbott Nutrition**

Thanh graduated from Capital University in 1998 with a Chemistry degree and immediately worked in the same department as a Lab Manager. Off campus, he managed his parents' Chinese-Vietnamese restaurant on evenings and weekends. After five years of business management role, he redirected his Chemistry knowledge to the industry world. He was a Chemist at Merieux NutriSciences for two years. He then focused his skills on micronutrient testing at Abbott Nutrition for four years, analyzing Vitamins and vital nutrients. Currently, he is a Scientist in the Global Flavor

Technology group of PR&D, where he uses his skills in Chemistry and Sensory to develop numerous flavor systems for various Abbott adult and pediatric nutritional products.



## STUDENT PRESENTATION SCHEDULE

## Oral Presentations // 9:30 am – 12:00 pm

## 9:30 am

**Sahar Maleki, Hathaway Brown School**  
*The Characterization of a Novel Role for Sxl in Meiosis*  
 Ruff Memorial Learning Center 02

**Rohan Kumar, University School**  
*Pain Management International Practice Patterns and Patient-Reported Outcomes Among Non-Dialysis CKD Patients: An Analysis from The CKDopps Study*  
 Ruff Memorial Learning Center 07

**Justice Arai, University School**  
*Designing and Testing UAV Propellers Inspired by Nocturnal Owl Flight to Reduce Noise and Improve Aerodynamic Performance*  
 Ruff Memorial Learning Center 102

**Sarah Theewis, Archbishop Alter High School**  
*The Efficacy of the Disinfection Process, Oxidation, with/out an Added Flocculant*  
 Ruff Memorial Learning Center 103

**Seema Akras, Hathaway Brown School**  
*Prefilled Syringe Testing of In-Use Hospital Drugs*  
 Ruff Memorial Learning Center 201

## 10:00 am

**Eashan Kosaraju, University School**  
*Predicting Pulmonary Hypertension by Electrocardiograms using Machine Learning Techniques*  
 Ruff Memorial Learning Center 02

**Pranitha Chillara, Dublin Coffman High School**  
*The Effect of Adjusting pH Before Treating an Algal Bloom with an Aluminum Sulfate*  
 Ruff Memorial Learning Center 06

**Bowen Jiang, Western Reserve Academy**  
*Six Single Nucleotide Polymorphisms Found on Two Different Chromosomes are Common Across Seven Distinct Cancer Types*  
 Ruff Memorial Learning Center 07

**Grant Congdon, West Geauga High School**  
*Comparing Accessibility Advantages Between Traditional Joystick, Electromyographic, and Gyroscopic and Accelerometer-Based Control to Drive an Electric Wheelchair*  
 Ruff Memorial Learning Center 102

**Josie Jennings, Global Impact STEM Academy**  
*The Study of Soil Fertility Nutrient Influence on Yield*  
 Ruff Memorial Learning Center 103

**Julia Zhu, Hathaway Brown School**  
*MFN2, A Potential Therapeutic Target for Alzheimer's Disease*  
 Ruff Memorial Learning Center 201

## 10:30 am

**Hans Swain, University School**  
*Effect of Excess Dietary Iron on Intestinal Tumorigenesis*  
 Ruff Memorial Learning Center 02

**Anika Yadati, Hathaway Brown School**  
*Assessing Skin Biomarkers in Parkinson's Disease*  
 Ruff Memorial Learning Center 06

**Ali Sedique, Ottawa Hills High School**  
*The Effects of Aeration Induced Stress on Zebrafish Learning, Memory, Aggression, and Anxiety*  
 Ruff Memorial Learning Center 07

**Bryn Morgan, West Geauga High School**  
*DSLR Camera Photometry and Star Tracking*  
 Ruff Memorial Learning Center 102

**Matthew Devine, University School**  
*UV Photodegradation of Byssal Thread Adhesives on Acrylic, Polystyrene, and Aluminum Substrates*  
 Ruff Memorial Learning Center 103

**Srestha Chattopadhyay, Sylvania Northview High School**  
*Development of Novel FLT3 Inhibitors to Overcome Drug Resistant Leukemia*  
 Ruff Memorial Learning Center 201

## 11:00 am

**Aiden Funkhouser, Hilltop High School**  
*Caffeine's Effect on Food Digestion: A Two Year Study*  
 Ruff Memorial Learning Center 02

**Ranie Roesch, Hilltop High School**  
*Effectiveness of Acne Cleansers on Staphylococcus epidermidis and Streptococcus salivarius*  
 Ruff Memorial Learning Center 06

**Ann Bixel, Upper Arlington High School**  
*How Adoption Stories Affect Perceptions of Identity*  
 Ruff Memorial Learning Center 07

**Shreeyans Bhavaraju, Univeristy School**  
*Detect Cyberbullying with AI: Which AI Model can Most Accurately Detect Toxic Language?*  
 Ruff Memorial Learning Center 102

**Aaron Velez, University School**  
*Effects of Dispersants on Photo-Oxidized vs Fresh Oil Simulated with Olive Oil and Laundry Detergent*  
 Ruff Memorial Learning Center 103

**Michael Zhu, University School**  
*Surface Engineering of Bioplastics*  
 Ruff Memorial Learning Center 201

## 11:30 am

**Julia Xi, Perrysburg High School**  
*A Numerical Study of the Microvirial Theorem with Three-body Gravitational Force Interactions*  
 Ruff Memorial Learning Center 02

~~**Rimel Kamran, The Summit Country Day School**  
*Oncological Patient Perception of Clinical Trials and Barriers to Enrollment in a Community Hospital*  
 Ruff Memorial Learning Center 06~~Withdrawn

**Audrey Lu, Columbus Academy**  
*Trends and Patterns of Prescription Opioid Overdose among Adolescents and Children between 2008 and 2020*  
 Ruff Memorial Learning Center 07

**Gavin Sheppard, University School**  
*Creating a Machine Learning Model to Predict Nick Chubb's Rushing Yards*  
 Ruff Memorial Learning Center 102

**James Bell, Hilltop High School**  
*Examining Produce Yield of Capsicum Annuum in Compost Enriched Soil While Tracking Household Waste Reduction*  
 Ruff Memorial Learning Center 103

**Ryan Chang, University School**  
*The Use of NSAIDs on Hemorrhagic Stroke-Affected Patients: A Meta-Analysis*  
 Ruff Memorial Learning Center 201

## Poster Presentations // Capital Center Field House // 1:30 pm – 3:00 pm

Laasya Acharya, William Mason High School  
*Gaea: A Model Utilizing Unsupervised Learning to Detect Pest Damage in Crops*

Allison Chinchar, North Ridgeville High School  
*The Naked Shorting on ETFs in the Modern Economy*

John D'Cruz, University School  
*Microplastics in the University School Water Filtration System*

Hua Fang, Hathaway Brown School  
*The Role of Voltage Gated Calcium Channel CaV1.2 in Blood-Brain-Barrier Damage and Neuroinflammation*

Shubhee Gandhi, Hathaway Brown School  
*Interactive Educational Astronaut Suit Fitting Room*

Alison Gunzler, Hathaway Brown School  
*Effect of Data Revisions on Coronavirus Model Accuracy*

Juliella Hankinson, Hankinson Home Academy  
*A Study of Chloride Retention Levels from Excess Use of Road Salt in Wolf Run Tributary in Comparison to Kokosing River Levels*

Olga Isailovic, Ottawa Hills High School  
*Determining the Relationship Between Fluorescent Phycocyanin and Microcystin Released from Cyanobacterial Cells Following Lysi*

Gabriella Joseph, Hathaway Brown School  
*Food Preference Study on Dung Beetles in Northeast Ohio*

Ishita Kopparapu, Hathaway Brown School  
*3D Human Stem Cell Model for Neurodevelopment*

Haasini Mendu, William Mason High School  
*Machine Learning Approach for the Detection of Glaucoma Based on Fundus Images*

William Monaghan, University School  
*Supersonic with Sugar*

Mohamed Musa, Sylvania Northview High School  
*Optimizing Photovoltaics*

Sujay Nalla, University School  
*Which Retainer Cleaning Method Removes Bacteria the Most Effectively?*

Evan O'Leary, Lehman Catholic High School  
*Machine Learning Algorithm*

Niklas Rietsch, University School  
*Meta-Analysis on the Length of Primary Cilia in Various Neurodegenerative Disorders*

Austin Rush, St. Francis DeSales High School  
*The Insights Learned From 3D Printing Shoes and What They Exemplify*

Aryan Singh, University School  
*Electric Vehicle Infrastructure Development in the United States*

Darelle Thornton, Firestone CLC  
*Radical Polymerization of CO<sub>2</sub> via 1,1 Azobis (Cyclohexane-1-carbonitrile), Zinc Chloride, and Ethylene Carbonate in the Creation of a Novel Renewable and Degradable Plastic*

Margaret Wheeler, Hilltop High School  
*The Strength of Threads and Stitch Types on Cotton Fabric*

Elena Winter, Hathaway Brown School  
*Isocitrate Dehydrogenase 1 Inhibition Sensitizes Melanoma to Temozolomide Chemotherapy*



## ABSTRACTS

**Laasya Acharya, William Mason High School**

***Gaea: A Model Utilizing Unsupervised Learning to Detect Pest Damage in Crops***

Poster Presentation: Capital Center Field House // 1:30 pm – 3:00 pm



Per the UN FAO, 40% of crops annually are lost world wide due to pest damage. Early detection of pests is crucial to reducing these losses, as farmers can then take preventative measures. However, current detection systems are costly, slow, and often based on lab data, leading to inaccurate diagnoses. Therefore, it is crucial to have on-site, accurate, fast, and economically viable detection techniques for pests. Gaea is a model integrating unsupervised neural-networks with a physical component to diagnose pest damage from images. The cohesive device has two separate systems. The first is a physical-device with a Raspberry-Pi Zero and camera, and an LCD. The second is the unsupervised neural network that analyzes the images taken by the device. The neural network utilized a Variational-Auto encoder model, allowing for a continually updating system. As a farmer takes more images, the network learns to classify them. This mitigates a critical issue in machine learning where, due to a lack of data, AI cannot be applied. The final network has a loss of 12.08% based on the NADAM network-optimizer and K-Means clustering-algorithm. In the end-to-end method, the user takes an image of the damaged crop using the device. The image is then analyzed through the network-system. The network then provides the diagnosis through the LCD. The user can then take preventative measures to stop the spread of a pest. In summary, Gaea successfully meets all its design-objectives, demonstrating that a multi-layered neural network can effectively be integrated with a physical-device for early-detection of pest-damage.

**Seema Akras, Hathaway Brown School**

***Prefilled Syringe Testing of In-Use Hospital Drugs***

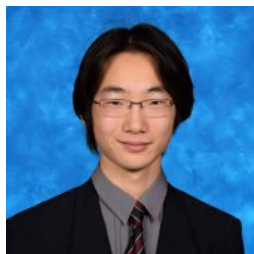
Oral Presentation: Ruff Memorial Learning Center 201 // 9:30 am

A prefilled syringe is a delivery device that ensures a safe, reliable, effortless, and dependable way to deliver a drug/medication to a patient in any setting necessary. Whether it be in an Operating Room or a hospital bed, prefilled syringes are meant to alleviate the issues of the multi-step process of manually drawing medicine from a vial with an empty syringe to then deliver to a patient. With adequate microbiological, chemical, and functional testing done on prefilled syringes one drug type at a time, at the Pharmaceutical company we focus primarily on the functional testing of the prefilled syringes to ensure their reliable use. Three machines, in particular, are used to determine the amount of forces required to push the plunger rod and twist the tip cap off of a syringe, and to ensure container closure integrity of the syringe tube itself while the drug resides inside. Four to five drug types have been tested in syringes in the past year and a half, with graphs and formal reports displaying their results. The FDA required each drug type to be tested in 3 batches of 60 syringes with their results then shared in a proper and backed-up manner so as to gain approval for the prefilled syringe's use in hospitals for that particular drug type. The force results of the drug types tested did not exceed the maximum forces able to be twisted for the tip cap or for pushing the plunger rod, and the air vacuum test has continually given decay amounts that have fallen in the average interval. Each batch of 60 syringes we test gives us a statistical confidence and reliability of 95%. This is what the FDA requires from the syringes that go through testing and what they require for submission, which is what we have been giving them. At times we saw differences between none experiment's data in comparison to another's, however, they are considered allowed differences and not irregular inconsistencies due to physical differences between the types of syringes tested being present.

**Justice Arai, University School**

***Designing and Testing UAV Propellers Inspired by Nocturnal Owl Flight to Reduce Noise and Improve Aerodynamic Performance***

Oral Presentation: Ruff Memorial Learning Center 102 // 9:30 am



Drones are infamous for their noise, and unfortunately, growing usage of UAVs across all disciplines have increased noise pollution, negatively impacting human health and the environment. Owls are known for their silent flight, with fringes at the trailing edges of their feathers mitigating turbulent eddies, and thus, noise. This feature was implemented in a biomimetic propeller design for this project. The engineering criteria for this project consisted of noise reduction, thrust improvement, and lightweight designs. Two modified propellers with trailing edge fringes were designed and 3D printed by the author, along with a control propeller without fringes, all possessing equal parameters. The fringes of the modified propellers being triangular in nature, each modified propeller contained a height to wavelength ratio of 0.3 and 1, respectively. After measuring the thrust and SPL (along with frequency analysis) at four different speeds from 5000 RPM to 11000 RPM, both propeller A ( $h/\lambda = 0.3$ ) and propeller B ( $h/\lambda = 1$ ) were able to reduce noise at all rotational speeds, while only propeller A improved aerodynamic efficiency. Analysis of sound frequency displayed further insight on the impact search frequency range had on the SPL for each propeller. Propeller A with a  $h$ -to  $\lambda$  ratio of 0.3 proved to successfully meet the criteria. This project proved that propellers with biomimetic features can reduce their impact of noise pollution, as well as reduce energy consumption in hopes of a sustainable future.

**James Bell, Hilltop High School**

***Examining Produce Yield of Capsicum annum in Compost Enriched Soil While Tracking Household Waste Reduction***

Oral Presentation: Ruff Memorial Learning Center 103 // 11:30 am

This project's purpose was to measure how much the addition of compost in soil would affect the growth of *Capsicum annum*. Compost boosts plant growth by adding vital nutrients to soil. Composting also reduces household waste which will lower the amount of trash sent to landfills. Ten seedlings of *Capsicum annum* were planted into two containers filled with the same type of potting soil; one set of plants had compost added to the soil while the other did not. For a 22-week growing period, the height of the plants and the number of peppers growing was recorded weekly. When the peppers were ripe, as denoted by a color change from green to red, they were harvested, weighed, and measured. The hypothesis that the *Capsicum annum* planted in compost enriched soil would have boosted plant growth defined by plant height and produce yield was supported. The average height of plants in composted soil was 45.2cm, whereas plants in regular soil measured 34.7cm at week 12 ( $p$ -value =  $1.3E-17$ ). The total number of peppers harvested in composted soil was 75 peppers whereas 14 peppers were harvested in regular soil ( $p$ -value =  $1.3E-2$ ). Data were statistically significant with  $p$ -values less than 0.05 which supports the hypothesis. Total waste reduction averaged 20L per month equating to five 13-gallon trash bags a year for a three-person household. This experiment emphasizes the environmental benefits of composting by reducing waste while also improving food production.

**Shreeyans Bhavaraju, Univeristy School**

***Detect Cyberbullying with AI: Which AI Model can Most Accurately Detect Toxic Language?***

Oral Presentation: Ruff Memorial Learning Center 102 // 11:00 am



The purpose of this project is to determine the best AI model between an LSTM model vs. a BERT model at detecting hateful speech. In order to test this, an LSTM model and BERT model were both tested using the same dataset in order to see how accurate each one is, the F1 scores of each, along with the percent data loss and total time taken to scan through a dataset. After testing both models with a dataset that contained up to 500,000 data points, it was observed that as more data were used, the more effective both models became at determining the intention of the text. At 500,000 data points, the LSTM model had an accuracy of 0.78 while the BERT model had an accuracy of 0.79. The LSTM model had an F1 score of 0.76 while the BERT model had an F1 score of 0.77. It is also worth noting that the BERT model over time had more data loss and less time taken to go through the dataset because the

LSTM model relies on previous data to make future predictions so over time it will lose less data and take longer to process more data. These results show that the BERT model was more effective. A potential future study would see how effective the BERT model would be when combining it with neural networks capable of sentiment analysis like CNN along with seeing the use of AI in healthcare.

**Ann Bixel, Upper Arlington High School**

***How Adoption Stories Affect Perceptions of Identity***

Oral Presentation: Ruff Memorial Learning Center 07 // 11:00 am



Based on qualitative interviews, this study posed the question of how adoption stories affect adoptees' perception of identity. For the purposes of this study, the adoption story is defined as the story that explains the child's journey into the adoptive family. From likes to dislikes, passions, and relationships, humans have always tried to fit themselves into the mold of what is called identity. However, for many transnational adoptees, questions about identity travel much deeper due to significant portions of their stories being redacted. Because Grounded Theory shows off the narrative behind the numbers, it is uniquely suited to the examination of the adoption story. Accordingly, this study analyzed coded interview transcripts to seek patterns, and compare and create themes that emerged from the data. Initial findings include frequent questioning of identity, grappling with unknowns, being seen as Asian while feeling White, and the experience of being stuck in between cultural identities without the privileges of either.

**Ryan Chang, University School**

***The Use of NSAIDs on Hemorrhagic Stroke-Affected Patients: A Meta-Analysis***

Oral Presentation: Ruff Memorial Learning Center 201 // 11:30 am



The purpose of this meta-analysis is to gain a greater understanding of hemorrhagic strokes and non-steroidal anti-inflammatory drugs (NSAIDs). Hemorrhagic strokes account for 13% of all strokes and occur when a blood vessel ruptures in the brain. NSAIDs are commonly used to relieve headaches but may have severe side effects. This meta-analysis aimed to determine whether NSAIDs had an increased risk for hemorrhagic stroke based on risk ratios. In this way, patients and NSAID producers can know the dangers of NSAIDs. The hypothesis was that if patients take NSAIDs, they will have an increased risk for hemorrhagic stroke, especially those taking COX-2 inhibitors because the enzyme mediates inflammation throughout the body. A literature search was conducted on Pubmed and PLoS

One with the search terms "hemorrhagic stroke," "stroke," "NSAID," and "non-steroidal anti-inflammatory drug." Patients were adult patients with reported NSAID usage confirmed with medical records and clinical examinations; 429 articles were reviewed. Fifteen articles were identified. There were a total of 2,256,807 patients taking NSAIDs remaining after the studies were completed, with those that underwent hemorrhagic stroke and those that did not. The two groups were comparable, with similar demographics. Through RR scores, the risk of hemorrhagic stroke was significantly increased inpatients taking any NSAIDs (95% confidence interval (CI): 1.07 to 1.21). Current evidence suggests that NSAID producers must take into consideration this new risk as they develop the drugs, including adding the risk of hemorrhagic stroke on the drug label.

**Srestha Chattopadhyay, Sylvania Northview High School**

***Development of Novel FLT3 Inhibitors to Overcome Drug Resistant Leukemia***

Oral Presentation: Ruff Memorial Learning Center 201 // 10:30 am



Cancer is a leading cause of death worldwide, and leukemia is responsible for significant fatalities in children. The Leukemia and Lymphoma Society reported more than 23,000 deaths caused by leukemia in 2021. Current drug therapies induce cellular death through apoptosis. However, apoptosis can promote relapse and drug resistance in cancer patients, so there is an urgent need to find alternate therapies. One such option can be to find alternate mechanisms of cancer cell death. Common cancer-targeting drugs promote FLT3 (a tyrosine kinase receptor) to mutate, promoting apoptosis, relapse, and chemo resistance against the drug. The dual objective is to study the effect of FLT3 inhibition on the percentage and type of cellular death. A high-throughput screening using a library of chemical compounds identified three prominent drugs that inhibit FLT3. The effects of these three drugs on cell death mechanisms of leukemic cells were studied using a microscope and Cell Titer-Blue assay. The results collected provide evidence that an FLT3 inhibitor induces non-apoptotic death. While all three compounds showed significant cell death and similar IC50 values in the micro molar range, CST-16 was found to be most effective. In addition, the CST-16 drug causes methuosis, which is a very efficient non-apoptotic method of death. Therefore, it can be inferred from past studies that there will be less cancer relapse and drug resistance. Together, it is shown that inhibition of FLT3 can be a helpful strategy in clinics to treat drug-resistant leukemia in patients in the future.

**Pranitha Chillara, Dublin Coffman High School**

***The Effect of Adjusting pH Before Treating an Algal Bloom with an Aluminum Sulfate***

Oral Presentation: Ruff Memorial Learning Center 06 // 10:00 am

Cyanobacterial algal blooms occur in slow-moving, warm, and nutrient-rich bodies of water (lakes and ponds) and are harmful because they lower the dissolved oxygen (DO) levels in the water, block sunlight from reaching underwater plants, and can release cyanotoxins in some cases; these blooms have been found in greater frequency and more places across the United States in the past several years. This study determines whether a widely used method to treat cyanobacterial algal blooms, an aluminum sulfate treatment, would be more effective if the pH of the algal bloom-affected water was treated first to fall in a neutral pH range. Sixteen clear containers with water in which an algal bloom had been stimulated were treated with the alum treatment; in eight of the containers, however, the pH was adjusted to a neutral range before the treatment was applied. A t-test was performed to determine whether the biomass of the algae after the aluminum treatment – this was measured in absorbance (au) by using a spectrophotometer at 760 nm – differed in the experimental and control containers; the *p*-value was found to be 0.00026. As this value is less than the critical value of 0.05 the alternate hypothesis was accepted. It was concluded with a 95% confidence level that adjusting the pH of the cyanobacterial bloom water before applying an alum treatment will result in lower biomass of algae in the pond water than if the alum treatment was applied without the adjustment of the pH.

**Allison Chinchar, North Ridgeville High School**  
***The Naked Shorting on ETFs in the Modern Economy***

Poster Presentation: Capital Center Field House // 1:30 pm – 3:00 pm



Executionary naked shorting, or cellar boxing, is a form of manipulation found within the stock market. To combat naked shorting, the SEC adopted Regulation SHO. Regulation SHO also includes the threshold list which publishes the securities that have an excessive amount of fails. Exchange-traded funds are relatively new securities that trade like stocks. Richard Evans (2019) found that around 1% of ETFs are failing at any given time. Additionally, many ETFs are always found on the threshold list. This study analyzes the effects naked shorting has on ETF behavior during a recessionary and calm period. A data analysis was performed on the Regulation SHO threshold list appearances and the French-Fama-Carhart 4 Factor Model was used on the ETFs with the most severe potential naked shorting cases. The ETF market was affected by the recession, but I found that it recovered very quickly. Additionally, the FFC 4 Factor model revealed that momentum was neither negative nor significant, indicating that cellar boxing does not take place in the modern ETF market.

The FFC4 Factor model also revealed that the only consistently significant factor was the market risk premium, indicating that ETFs fail simply because of the market conditions. I show how executionary naked shorting is not pervasive in the modern ETF market.

**Grant Congdon, West Geauga High School**

***Comparing Accessibility Advantages Between Traditional Joystick, Electromyographic, and Gyroscopic and Accelerometer-Based Control to Drive an Electric Wheelchair***

Oral Presentation: Ruff Memorial Learning Center 102 // 10:00 am



In recent years, prosthetics from hands to feet have become more affordable. They have also changed many people's lives by giving them back mobility. Yet, wheelchair technology has remained limited to primarily arm-driven navigation and is still ineffective for many people with quadriplegia. Current solutions to these dilemmas are often extremely costly and difficult to use. To find the best alternative method for wheelchair driving systems, a comparative analysis was performed between the joystick model, a gyroscope headset, and an electromyograph headset. Data on response delay, granularity, cost, and complexity were measured for each system to determine how each was best situated for a target audience. Response time was recorded based on how long each program spent processing data before sending a command to the Arduino to run the motors. Granularity was measured by calculating the theoretical smallest change the sensor could detect and translating that

into how much the wheelchair's speed would be affected. Complexity was displayed in a flow chart, demonstrating how many steps each program would have to go through to run through the logic of each system completely. Finally, the cost was measured by finding the components' total price outside the wheelchair electronics. The joystick wheel chair was found to have the lowest response delays, cost, and complexity, and the electromyograph headset had the smallest amount of granularity. The gyroscope-based headset, however, was the most accessible given its easy calibration to people of all abilities, low cost, small granularity, and negligible complexity.

**John D'Cruz, University School**

***Microplastics in the University School Water Filtration System***

Poster Presentation: Capital Center Field House // 1:30 pm – 3:00 pm

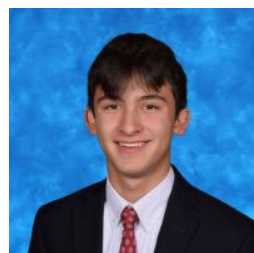


Are there microplastics in the University School water filtration system? This experiment tested different stages of the water filtration system at University School to document microplastic presence and determine what stage of the filtration process removed most microplastics. At University School, dirty water from the school goes through the water treatment plant and to a holding tank, where water flows into a series of artificial lagoons. These lagoons allow water to sit for extended periods of time, letting contaminants settle to the bottom. This filtered water is then let into a creek. The goal was to document possible presence of microplastics and determine if artificial lagoons were good microplastics filters. The hypothesis stated microplastics would be found in the filtration system, and after going through lagoons 2 and 3, microplastics would be least, because water would have the most time to sit, sinking microplastics through sedimentation. In the experiment, water was collected from the holding tank, lagoon 1, lagoon 2, and lagoon 3 in 1L containers, which was repeated 5 times. Next, samples were filtered using vacuum filtration to sort out solid contaminants. Each filter was observed under a dissecting microscope, and all suspected microplastics were kept for further examination. The burn test and close observation under high magnification were two strategies used to determine if specimens were microplastics. The data collected disproved the hypothesis, because no microplastics were found. Future testing with greater volumes of water and samples from before the treatment plant would be desirable to confirm results.

**Matthew Devine, University School**

***UV Photodegradation of Byssal Thread Adhesives on Acrylic, Polystyrene, and Aluminum Substrates***

Oral Presentation: Ruff Memorial Learning Center 103 // 10:30 am



In recent years, zebra mussels have spread throughout Lake Erie. The mussels have attached to water intake pipes, compromising their function. This causes power plants and water treatment plants to run less efficiently, increasing the cost to run these facilities. This study observes the effects of ultraviolet radiation on an adhesive similarly composed to the one secreted by mussels. Three substances were tested with and without UV treatment on three different substrates: Polyethylenimine (PEI) solution (0.052M), a polymer made of catechol solution (0.058M) and PEI solution (0.052 M) in a 1:10 ratio catechol solution to PEI solution, and a polymer made of catechol solution (0.029M) and PEI solution (0.052M) in a 1:10 ratio catechol solution to PEI solution. The substrates used were sheet aluminum, acrylic, and styrene. The substances were used to adhere overlapping 1" x 3" slides of the respective substrates together. Half of the samples were treated with 4 hours of UV light each day for 7 days. The strength of each adhesive was tested through the use of a force table: the measurement of adhesive strength was the amount of force needed to shear the slides apart, or tensile strength (newtons). No adhesives successfully adhered the aluminum slides together. On the acrylic and styrene, PEI initially showed weak tensile strength, and the UV treatment resulted in decreased tensile strength. Both catechol polymers exhibited high tensile strength and strong adhesion with the plastics, as well as decreased tensile strength after UV treatment.

**Hua Fang, Hathaway Brown School**

***The Role of Voltage Gated Calcium Channel CaV1.2 in Blood-Brain-Barrier Damage and Neuroinflammation***

Poster Presentation: Capital Center Field House // 1:30 pm – 3:00 pm

Gain and loss of function mutations in CACNA1C are associated with neuropsychiatric disorders such as autism, schizophrenia, depression, anxiety, and PTSD. CACNA1C regulates CaV1.2, a voltage gated calcium channel. Blood-brain-barrier (BBB) damage is often associated with these neuropsychiatric diseases. BBB damage can be either structural or functional, with structural damage including loss of tight junctions and endothelial cell degradation, and functional damage including leakage of the BBB. Using a brain Cacna1c KO model and a TS2 mouse model, we show that brain Cacna1c KO mice exhibit increased BBB leakage using dextran extraversion assays and IgG staining. By using Western blots and immunohistochemistry, we also show the brain Cacna1c KO mice exhibit neuroinflammation. We show that gain of function mutations in Cacna1c do not contribute to BBB damage or neuroinflammation with immunohistochemistry. Our study establishes a possible link between BBB damage and CACNA1C deletion.

**Aiden Funkhouser, Hilltop High School**

***Caffeine's Effect on Food Digestion: A Two Year Study***

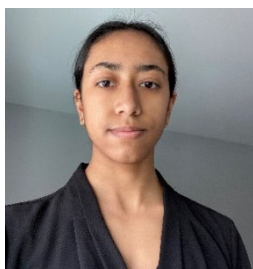
Oral Presentation: Ruff Memorial Learning Center 02 // 11:00 am

The purpose of this project was to find out how caffeine affects the digestion rate of different foods. This research will help the public understand how caffeine affects the digestive system and if caffeine intake should be monitored more frequently. People with digestive problems can use this research to determine if they should limit caffeine intake. One hundred twenty six total food samples with gastric juice and different caffeine supplements were tested. Thirty mL of each gastric juice and a caffeine supplement were added to glass jars containing the food samples and placed on a rotator for seven hours. The food samples were left to dry for three days and then measured to compare pre to post mass to determine the amount lost. Neither of the hypotheses were supported. It was found that caffeine did not significantly increase rates of digestion. Results showed that the more caffeine added did not significantly increase rates of digestion. The average digestion in gastric juice was 4.7g compared to the average of 4.8g in all caffeine sources. The caffeine pills average loss was 5.4g, Coffee's average loss was 5.9g, Monster's average loss was 3.9g, Mountain Dew's average loss was 4.5g, Pepsi's average loss was 4.2g. An unpaired t-test showed that the increased digestion in the coffee and caffeine pills was not statistically significant. Also, the decreased digestion in the Monster, Mountain Dew, and Pepsi was not statistically significant. The varying levels of caffeine did not significantly affect the digestion of meat, lettuce, green beans, bread, watermelon, apple's, and avocado's which were the foods used in this experiment.

**Shubhee Gandhi, Hathaway Brown School**

***Interactive Educational Astronaut Suit Fitting Room***

Poster Presentation: Capital Center Field House // 1:30 pm – 3:00 pm



The NASA Glenn Research Center's Graphics and Visualization Lab (GVIS) often does outreach events for children to demonstrate NASA's achievements and future projects. However, with all the new mixed reality simulations, the demonstrated technologies far outdid the photo opportunities, which consisted of a cardboard cutout. The interactive, educational astronaut suit fitting room was created to have an augmented virtuality showcase and photo opportunity. The users would be able to try on various astronaut suits, move around with the suits, grab and move a flag, and play golf. Furthermore, it would serve an educational purpose by teaching about the problems of lunar dust, the different types of astronaut suits, and the history of golf on the moon.

**Alison Gunzler, Hathaway Brown School**

***Effect of Data Revisions on Coronavirus Model Accuracy***

Poster Presentation: Capital Center Field House // 1:30 pm – 3:00 pm



All models for the current Covid-19 pandemic rely on reported case data (truth data) to accurately predict future cases. However, this data is often incorrect at the time of reporting and will be revised at a later date after the models have already made predictions. Over the course of the project, a series of linear regression models were created to determine the significance and effect that both the absolute and percent difference in revisions has on the overall weighted interval score (WIS score), which is a metric used to evaluate forecast accuracy. The most accurate of these models were selected and the p-value and coefficient of the independent variables were determined. Ultimately, the absolute difference had a significant positive effect on model accuracy while the percent difference was not important, after accounting for confounding variables. Therefore, large

inaccuracies in truth data affect the ability of a model to accurately forecast COVID-19 cases, regardless of the number of cases that occurred in a given location.

**Juliella Hankinson, Hankinson Home Academy**

***A Study of Chloride Retention Levels from Excess Use of Road Salt in Wolf Run Tributary in Comparison to Kokosing River Levels***

Poster Presentation: Capital Center Field House // 1:30 pm – 3:00 pm



As snow blows in drifts over the roads, large trucks, full of salt, drive slowly and carefully over them, laying down salt as they do so. Road salt is often applied to roads in winter to lower freezing levels of precipitation, causing ice and snow to melt, clearing off the roads. Afterwards, salt is washed off roads into soil and nearby waterways. The goal of this study is to determine and compare the level of road salt at Wolf Run, a tributary of the Kokosing River in Knox County, Ohio and the area downstream from where the tributary feeds into the river. As well as compare results to last years' results. Chloride levels were tested using Quantab Chloride test strips and compared to results obtained 2021-2022 for a separate study at the same locations. Macroinvertebrates, wildlife, and any changes in the stream and streambank were documented. Results indicate higher chloride levels in the second year of testing the tributary for comparable measurements of temperature and water

level from the previous year. Results indicate a 0.4 quantab unit increase from the previous year. Additionally, this study confirms the hypothesis that tributaries; such as Wolf Run, with lower levels of water than rivers may be the first to exhibit signs that the overall water system is in danger of becoming overloaded with salt and it may point to a concern that chloride levels rise each year.

**Olga Isailovic, Ottawa Hills High School**

***Determining the Relationship Between Fluorescent Phycocyanin and Microcystin Released from Cyanobacterial Cells Following Lysi***

Poster Presentation: Capital Center Field House // 1:30 pm – 3:00 pm

In utilizing two varying methods of lysing cyanobacterial cells in Lake Erie freshwater, mass spectrometry is the central method used to repeatedly identify levels of both phycocyanin and microcystin in *Microcystis aeruginosa* cells. Using one cumulative collection from the southwestern Lake Erie shore during algal bloom season in July 2022, 16 samples were collected and analyzed to examine the proportion of phycocyanin proteins to microcystin peptides. With seven samples of sonicated-induced lysed cells extracted at 2.5 mL each, seven samples of freeze-thaw-induced lysed cells extracted at 2.5 mL each, and three control samples only subject to filtration prior to extraction, a variety of cell conditions were modeled in assessing levels of phycocyanin in proportion to microcystin. The values were put in statistical software to determine various measured of statistical significance, including but not limited to a least squares regression line predicting the amount of microcystin for a given quantity of phycocyanin, the standard error for the least squares regression line, the regression line's



coefficient of determination, the standard error of the least squares regression line in comparison to each sample, and a residual graph.

**Josie Jennings, Global Impact STEM Academy**

***The Study of Soil Fertility Nutrient Influence on Yield***

Oral Presentation: Ruff Memorial Learning Center 103 // 10:00 am

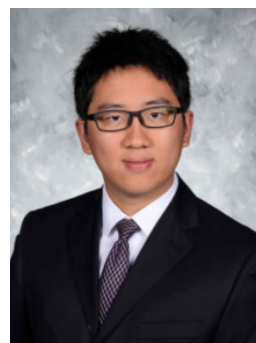


This study explored the impacts of organic matter, phosphorus, and potassium on soybean productions, and how it can be evaluated with data collections from the Agronomic Technology department at Advanced Agrilytics. Implementing this type of data in operations is becoming more prioritized through precision farming equipment that analyzes field data during production activities. As precision technology use increases, it is crucial to understand analytics such as this to determine the best additives and plan for field plots. Soil fertility profiling data was utilized to identify the most influencing nutrient in comparison to yield records. Looking at the average amount of crop that is harvested from start of production to finish allows results to compare the fluctuation between yield and the elements tested. Extracted soil profiling samples included data collected over a span of eight years on five different fields with varying geography, soil types, and seed varieties. In this study, organic matter showed the most reflection between its percentage levels and final yield over time, however the other variables were an extremely close follow. The aim was to discover which element must be emphasized in fertilizers or active in soil to best benefit soybean quality, but the results proposed an alternative idea that perhaps they all have an avid contribution to the successes of the seasonal yield when present at the same time.

**Bowen Jiang, Western Reserve Academy**

***Six Single Nucleotide Polymorphisms Found on Two Different Chromosomes are Common Across Seven Distinct Cancer Types***

Oral Presentation: Ruff Memorial Learning Center 07 // 10:00 am



Successful cancer treatment relies on understanding its etiology and the early detection of symptomatic patients. The identification of single nucleotide polymorphisms (SNPs) shared between distinct cancers can assist in furthering our understanding and serve as possible biomarkers. To investigate this objective, whole genome sequencing data were obtained from the Sequence Read Archive and then analysis pipelines constructed to map the sequences against chromosomes one and ten followed by indexing and variant calling. The chromosome one SNPs rs1418729588, rs1248545208, rs879148104 and the chromosome ten SNPs rs1321310328, rs1458969220, rs1836976520 were found to be shared by 7 different cancers that ranged from breast to prostate cancer. Our analyses identified cross-cancer SNPs that lay the foundation for future etiological studies and suggest that different cancers share common SNPs that may serve as suitable biomarkers.

**Gabriella Joseph, Hathaway Brown School**

***Food Preference Study on Dung Beetles in Northeast Ohio***

Poster Presentation: Capital Center Field House // 1:30 pm – 3:00 pm



This report is a food preference study on dung beetles in Northeast Ohio using dung from the Cleveland Museum of Natural History Perkins Wildlife Center. The baits consist of mushroom, red fox, gray fox, hare, coyote, bobcat, and raccoon dung. The traps were set in Ashtabula county at Grand River Terraces at three sites using a pitfall trap method where a cup is level with the ground and filled with propylene glycol for preservation of specimens. It is baited with the dung wrapped in cheesecloth and suspended from a roof to protect the trap. It was found that *Onthophagus striatulus* was the most abundant dung beetle in the area having a preference towards mushroom and coyote dung. Overall, coyote dung was the most successful with 37.7% of the dung beetles preferring such bait types. It was also noticed that *O. orpheus* highly selects gray fox as their favorite bait type which could be a future threat as gray foxes are declining in the region.

**Rimel Kamran, The Summit Country Day School**

***Oncological Patient Perception of Clinical Trials and Barriers to Enrollment in a Community Hospital*** ~~Withdrawn~~

Oral Presentation: Ruff Memorial Learning Center 06 // 11:30 am



With an estimated 1.9 million cancer cases to be diagnosed in 2022, cancer is the second leading cause of death in the United States. Clinical trials play a pivotal role in development and advancement of therapies and medications to combat cancer diagnoses and require the necessary patient participation to effectively collect and analyze the acquired data for the diverse population. However, patient participation is influenced by various factors hindering patient enrollment, and thus, patient accrual. This study evaluated patient perception of clinical trials and barriers to enrollment in a community hospital. A 24-question survey focused on patient attitude toward clinical trial participation was administered in two consecutive episodes to 111 eligible patients treated at The Christ Hospital Cancer Center's Infusion Room in Cincinnati, OH between January and July 2022.

Statistical analysis of 95 completed surveys examined relationships between survey responses and demographical identifiers such as race, gender, insurance type, employment status, and cancer type. Overall, study participants held mainly positive attitudes towards research studies: 36.84% of participants held a positive attitude towards research studies and 35.79% held a very positive attitude. Approximately 98% of all participants viewed research studies as either very important or important in making advances to medical treatments. No significant differences in general attitude towards clinical trials were identified based on race, gender, cancer type or commute to treatment center. Continued efforts should be made to understand how to promote participant accrual in research studies since patients view research studies positively but refrain from enrolling in them.

**Ishita Kopparapu, Hathaway Brown School**

***3D Human Stem Cell Model for Neurodevelopment***

Poster Presentation: Capital Center Field House // 1:30 pm – 3:00 pm



Organoids are 3D stem cell models which recapitulate the physiology of the human organs and are derived from induced pluripotent stem cells (iPSCs). The purpose of this project was to optimize cortical organoid differentiation protocol to be implemented in neurodevelopment and disease progression studies. Animal models such as mice have limitations such as inaccurate representation of the human brain development, and 2D models such as iPSCs have limitations with regard to being able to explore development through cell to cell interactions. However, organoids present a unique model as they are more effective and much closer to that of a human organ's physiology. iPSCs were cultured until completely confluent and later differentiated into cortical organoids in order to study neurodevelopment. When observing the organoids, morphology and electrophysiology were deeply studied. Results showed that at specific time points, the cell types within the organoid began to migrate. With the specific protocol used, neural

rosettes formed later compared to other protocols, however, rosettes indicate neural development as they are known to be representative of the neural tube. The objective of optimizing the protocol was to shorten the process and increase the effectiveness of the differentiation process.

**Eashan Kosaraju, University School**

***Predicting Pulmonary Hypertension by Electrocardiograms using Machine Learning Techniques***

Oral Presentation: Ruff Memorial Learning Center 02 // 10:00 am

Pulmonary hypertension (PH) is a condition defined as high blood pressure that affects the arteries in the lungs and the right side of the heart. Pulmonary artery hypertension (PAH) is a condition where a mean pulmonary artery pressure is greater than 25 mmHg. Estimated 5-year survival rate from the time of diagnosis of pulmonary hypertension is only 57% without therapy and patients with right heart failure only survive for approximately 1 year without treatment. Given the indolent nature of the disease, early detection of PH remains a challenge leading to delay in therapy. Echocardiography is currently used as a screening tool for diagnosing PH. However, electrocardiography (ECG), a more accessible, simple to use, and cost-effective tool compared to echocardiography, is less studied and explored for screening at-risk patients for PH. The goal for this project is to create a neural network model which can process an ECG signal and detect the presence of PH with a confidence probability. The dense neural network (DNN) model has an accuracy of 98% over the available training sample. To continuously improve the accuracy, the current model will be updated with a model suited for a time-series data. To balance the dataset with proper training samples, additional data will be generated using data augmentation techniques. Through early and accurate detection of conditions such as PH, we widen the spectrum of innovation in detecting chronic life-threatening health conditions and reduce associated mortality and morbidity.

**Rohan Kumar, University School**

***Pain Management International Practice Patterns and Patient-Reported Outcomes Among Non-Dialysis CKD Patients: An Analysis from The CKDopps Study***

Oral Presentation: Ruff Memorial Learning Center 07 // 9:30 am

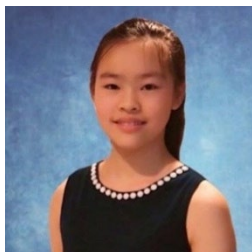


Approximately 82% of patients with an advanced stage of CKD, end-stage renal disease (ESRD), suffer from moderate-to-severe pain. Contributing factors include incorrect perception of analgesic usage, fear of addiction, and failure to seek treatment. We seek to describe international practice patterns for pain management among non-dialysis-dependent CKD patients and associations between quality of life, depression, and functionality. Data was obtained from questionnaire responses from patients in Brazil, Germany, and the US. The assessments were compared with three binary indicators. Patient characteristics were evaluated using linear probability models to assess the associations between self-reported pain and outcomes. Patients who described being extremely affected by pain were typically older, had lower eGFR, higher BMI, and reported a greater number of comorbidities. Worse levels of pain were associated with poorer health-related quality of life, measured by SF-12 subdomains. Patients more bothered by pain reported lower levels of general health, physical function, and emotional role. The proportion of patients receiving any analgesic increased from 26.7% in those not reporting pain to 55.2% among those extremely bothered. Opioid use is associated with numerous adverse health consequences and its prevalence and usage are increasing worldwide. The present study highlights the global trends in practices for analgesic use in late-stage CKD. Further studies will need to be done to examine more specific factors that lead to an increase in opioid prescriptions and national guidelines will need to be written to ensure nephrologists and other healthcare members have safe and healthy prescribing patterns.

**Audrey Lu, Columbus Academy**

***Trends and Patterns of Prescription Opioid Overdose among Adolescents and Children between 2008 and 2020***

Oral Presentation: Ruff Memorial Learning Center 07 // 11:30 am



The current opioid epidemic in the U.S. is an urgent national crisis that has devastating consequences on public health and economics. Extensive studies have been conducted to evaluate overdose impacts on adults, and several guidelines have been implemented to reduce opioid over-prescriptions for them. However, there is limited research on the scope of opioid overdose for adolescents and children, who has nearly doubled risk of opioid-dependence later in life after exposure. Also, the adult guidelines may not be fully applicable for reducing the amounts of opioids prescribed for children. In this study, we use the Nationwide Emergency Department Sample (NEDS) data sets to provide accurate national-level estimates of annual pediatric opioid-prescription-related

ED visits, examine the trends in pediatric opioid overdoses from 2008 to 2020, and identify multiple sociodemographic subgroups that are most at risk. We extract pediatric overdose cases from the NEDS based on the International Classification of Diseases billing codes, and then use advanced data analysis methods to account for the NEDS stratified sampling design. We find that pediatric ED visits decreased 22% from 2008 to 2019, possibly a spillover effect of the implementation of adult prescription guidelines. Adolescents 12 to 18 years old and infants 0 to 2 years old had the highest incidence rates, and females had higher rates of ED overdose visits than males. It is worth noting that several subgroups experienced a spike in 2020, likely due to the pandemic. These findings provide physicians and policymakers with valuable information for making pediatric opioid prescribing decisions and guidelines.

**Sahar Maleki, Hathaway Brown School**

***The Characterization of a Novel Role for Sxl in Meiosis***

Oral Presentation: Ruff Memorial Learning Center 02 // 9:30 am



Sex lethal (Sxl) is a binding protein required for sex determination in *Drosophila melanogaster* embryos. Prior experimentation in the Salz Lab at Case Western Reserve University suggested that the loss of expression of Sxl in the germline of *Drosophila* has implications upon the meiotic process, due to the increase in chromosomal nondisjunction rates when offspring had this protein turned OFF later in the germline. Therefore, it is speculated that Sxl plays a role in the meiotic processes of *Drosophila*. In this study, nondisjunction rates were scored to determine what role, if any, Sxl has in meiosis, and to evaluate whether or not a loss of Sxl expression in the germline has implications on the resulting nondisjunction rates. Wild type offspring (control+) were compared to offspring in which nanos-GAL4 (control-) and mata-GAL4 (experimental) drove the expression of Sxl in the germline, in order to replicate the prior study. The results of the control+ group remained consistent

with naturally occurring nondisjunction rates in genetically un-altered organisms. Both the control- and experimental groups produced results that maintained the prior research's findings regarding Sxl expression in the germline, in that the female offspring from neither group survived, indicating that a loss of Sxl in the embryonic stage produces female-centric lethality. Further experimentations with different genetic lines, bam-GAL4 and otu-GAL4, has since been completed and yielded the conclusion that Sxl does not affect the meiotic processes of these lines in *Drosophila*. To further understand the role Sxl plays in meiosis, experimentation should continue with ovarian staining and imaging of the *Drosophila*. Through the imaging process, the point in the germline at which Sxl is turned off, based on the genetic line used, would be made clear and thus could be more easily manipulated to research Sxl in the *Drosophila* meiotic process.

**Haasini Mendu, William Mason High School**

***Machine Learning Approach for the Detection of Glaucoma Based on Fundus Images***

Poster Presentation: Capital Center Field House // 1:30 pm – 3:00 pm

Glaucoma is the leading cause of irreversible blindness, affecting more than 80 million people worldwide. Caused by damage to the optic nerve and accumulation of aqueous humor, Glaucoma is a chronic progressive eye-condition. While the early detection of Glaucoma can help slow down symptom progression, current diagnostic methods rely on expensive imaging

techniques inaccessible to roughly 90% of individuals of lower socioeconomic status. With the growing development of ML classification algorithms, I hypothesized that I could develop a machine learning model that can distinguish between individuals with and without Glaucoma using fundus image data with an accuracy of at least 80%. The model was trained on the RIM-ONE dataset from the MIAAG repository, which contains 172 glaucomatic and 313 healthy individual samples. In phase 2, I determined the best classification algorithm through training AlexNet, VGG19, and GoogLeNet. The VGG19 model composed of 19 layers had the highest accuracy of 84.93% through transfer learning. The goal of phase 3 was to fine tune the model and identify irrelevant features for classification from fundus images through segmentation. The optimized AlexNet model trained on the segmented data achieved the highest accuracy of 94.17%. As fundus samples are easily and inexpensively analyzed, this application can potentially make intervention possible before the onset of irreversible blindness.

**William Monaghan, University School**

***Supersonic with Sugar***

Poster Presentation: Capital Center Field House // 1:30 pm – 3:00 pm



Unlicensed rocketeers have limited options in terms of fuels for their rockets, sugar being one of the most used due to how easy it is to get into. One of the main reasons for its legal openness is because of its remarkably low power. The purpose of this project was to create a bell rocket nozzle capable of making the exhaust produced by the combustion of potassium nitrate and sugar supersonic, testing the capabilities of sugar as a rocket fuel. This project started by making fuel in solid pieces, perfect cylinders that were easy to produce. As time went on, a mold was used to increase the surface area of the fuel. The fuel started off as purely sugar and potassium nitrate, but iron oxide was later mixed in to boost the power of the fuel. The rig was originally a 1" pipe with a homemade bolt-action nozzle but was later upgraded to standard threading as the bolt could not contain pressure. The nozzle was modified periodically to increase thrust and exhaust velocity. If this experiment were run again,

different manufacturing processes for the nozzles would also experiment with, like lathing them. In the end, supersonic speeds were not achieved. However, much was learned much about the making of sugar fuels, and the construction of nozzles. This research would benefit any junior rocketeer looking to boost the power of their rocket without changing the fuel itself.

**Bryn Morgan, West Geauga High School**

***DSLR Camera Photometry and Star Tracking***

Oral Presentation: Ruff Memorial Learning Center 102 // 10:30 am

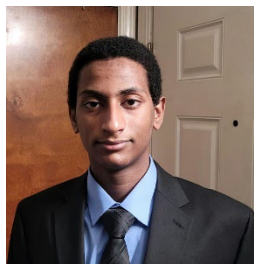


Photometry is an area of astronomy that involves measuring the magnitude of stars and other celestial objects. Traditional photometry observations require thousands of dollars of equipment and complex proprietary software, making it widely unpopular and inaccessible to amateur astronomers. The goal of this project was to determine the efficacy of inexpensive, consumer Digital Single Lens Reflex (DSLR) cameras and lenses by optimizing the process of photometry to produce the most accurate results possible with affordable and accessible hardware and software. This optimization analyzed a variety of factors, including camera sensitivity, location in the frame, focus level, exposure length, overall exposure time, and processing type. The Pleiades star cluster was analyzed for this project, chosen for its optimal positioning in the sky during testing, similar star magnitudes, and

recognizability. A prototype equatorial star-tracking mount was also designed and tested to examine the impact of star tracking vs manual tracking on the accuracy of photometry results. After taking a wide variety of images, the most influential factors were camera sensitivity (ISO), distance from the center of the frame, processing type, and exposure time. Other factors, such as star roundness, and overall exposure length were less influential, only causing errors at extreme values. In optimal conditions without a tracking mount, this system was able to achieve an average of close to .01 magnitude error repeatably, an acceptable error for measuring many variable stars, and showing that inexpensive consumer equipment is capable of high-accuracy photometry.

**Mohamed Musa, Sylvania Northview High School*****Optimizing Photovoltaics***

Poster Presentation: Capital Center Field House // 1:30 pm – 3:00 pm



In solar panels, electrons get excited into a higher energy level with the light they capture. The charge of the excited electrons and the now, empty and originally neutral, place they jumped from make a positive empty hole and negative electron pair separated by the forbidden gap making a difference charge difference. Like two ends of a magnet, the electron-hole pair attracts each other, and the electron travels through an external circuit, part of it on the solar cell, making a circuit generating energy acting, eventually meeting the hole and starting over capturing more light. For the external circuit the electron has to travel through, energy is lost because “wires” are resistive, losing some energy to heat; to prevent loss to heat in the “wire”, having conductive layers is standard procedure. In Cadmium Telluride (CdTe) photovoltaic cells, transparent conductive oxides (TCOs) are used for one side of the circuit and Copper Chloride (CuCl<sub>2</sub>) is used as the other side on the positive side. After applying and testing the conductive layer with CuCl<sub>2</sub> in tandem with single walled carbon nanotubes (SWCNT) handled in a sodium dodecylbenzenesulfonate (SDBS) solution in various manners, it was found that heating the photovoltaic cells multiple to apply multiple conductive layers on one side is inefficient. Although using SWCNT right before applying and heating CuCl<sub>2</sub> shows promise, using only CuCl<sub>2</sub> as a conductive layer for the positive side.

**Sujay Nalla, University School*****Which Retainer Cleaning Method Removes Bacteria the Most Effectively?***

Poster Presentation: Capital Center Field House // 1:30 pm – 3:00 pm



This study investigated the impact of different cleaning methods on the bacterial colonization of dental retainers to determine their antimicrobial efficiency. The five cleaning methods: rinsing with water, brushing with toothpaste, soaking in cleaning tablets solution, soaking in white vinegar solution, and brushing with baking soda paste. The results of the experiment can be used by people who wear retainers to evaluate which cleaning method is most efficient and whether they use it to their advantage to maintain oral health. After cleaning the retainer, gently wipe the cotton swab's tip across the agar plate's surface after rubbing the cleaned retainer with it. The agar plates would be kept in an incubator for three days at a temperature of 37°C to allow the bacterial colonies to fully develop. Each cleaning method is performed five times, totaling 25 trials. After that, pictures of the bacteria-filled agar plates are analyzed using ImageJ software, to analyze and count the pixels in the selected image. The hypothesis was if a retainer is cleaned by toothpaste, then it would remove the most bacteria compared to other cleaning methods. The experiment results showed that the retainer would have the fewest average bacteria colonies when it is cleaned with a baking soda paste, however, since the standard error bars overlap, the results do not provide any conclusion as to which is the most effective cleaning method of a retainer. The hypothesis was not supported by the results.

**Evan O'Leary, Lehman Catholic High School*****Machine Learning Algorithm***

Poster Presentation: Capital Center Field House // 1:30 pm – 3:00 pm

Machine learning involves creating computer algorithms to find patterns within large amounts of data. I have created a program that plays a game against a human player. It uses a machine learning algorithm to learn to beat the human player. The program uses the pattern of the player's previous moves to predict the next move. The program was tested in an experiment with many trials and many subjects to see if the computer would win over a longer period of time. The hypothesis that was tested in this experiment was if the player plays more turns then the performance of the computer will improve overtime. The results showed the hypothesis to be true. This program demonstrates the human brain runs on a pattern. This experiment also involved another program that had the player be represented by picking random moves. The result of this was the computer was not able to beat a player who made random moves.

**Niklas Rietsch, University School**

***Meta-Analysis on the Length of Primary Cilia in Various Neurodegenerative Disorders***

Poster Presentation: Capital Center Field House // 1:30 pm – 3:00 pm

It has been proposed that the primary cilium, a cellular organelle involved in cellular signaling, is involved in a wide variety of neurodegenerative diseases. However, little is known about the relationship between various neurological disorders and the length of primary cilia in the brain. Depending on the region of the brain, the effect that a neurodegenerative disease has on the length of the primary cilia can vary. This meta-analysis aimed to find broader correlations between the lengths of primary cilia in various regions of the brain in correlation to the effect that a neurodegenerative disease has on it. A literature search was conducted on Pubmed, EBSCOHost, and PLoS One with the general search terms “primary cilia”, “length”, and “neurodegenerative”; alongside the specific search terms of “Parkinson's”, “Alzheimer's”, “Amyotrophic Lateral Sclerosis”, and “Huntington's”. Additional reference articles were also included. 197 articles were reviewed. 6 articles were identified. The major result of this study was that there appears to be a correlation between the increased accumulation of proteins produced in excess as a result of neurodegenerative disorders and the shortening of primary cilia length. However, whether the shortening of the primary cilia is a result of the aberrant accumulation of proteins requires further research.

**Ranie Roesch, Hilltop High School**

***Effectiveness of Acne Cleansers on Staphylococcus epidermidis and Streptococcus salivarius***

Oral Presentation: Ruff Memorial Learning Center 06 // 11:00 am

The purpose of this project was to determine which type of face cleanser eliminates the most bacteria. This project is important to society because it will help show what face cleansers actually work to help get rid of bacteria that grow on a person's face and contribute to acne. The face cleanser that was predicted to have the largest ring of inhibition between both low-end and high-end cleansers was the Glow Recipe cleanser. This project used 30 nutrient agar petri dishes inoculated with *Staphylococcus epidermidis* and 60 potato dextrose agar petri dishes inoculated with *Streptococcus salivarius*. Disks were soaked in each face cleanser for 15 minutes. The high-end face cleansers were tested on both samples, while the low-end cleansers were tested to complete year one trials. Fifteen disks for each cleanser were then placed onto the petri dishes and incubated for 48 hours at 37°C. The rings of inhibition were measured and averaged for each cleanser. CeraVe Renewing SA Cleanser had the biggest ring of inhibition with an overall average of 13.9mm in both high and low end. This was significantly larger ( $p = 0.0001$ ) than the hypothesized Glow Recipe facial cleanser. The high-end cleansers were compared to the low-end facial cleansers. The low-end facial cleansers had an average ring of inhibition of 8.2mm, while the high end had an average of 8.7mm. While the high-end facial cleansers have a cost of almost three times the amount of the low-end cleansers, there was no significant overall difference observed.

**Austin Rush, St. Francis DeSales High School**

***The Insights Learned From 3D Printing Shoes and What They Exemplify***

Poster Presentation: Capital Center Field House // 1:30 pm – 3:00 pm



I challenged myself to 3D print shoes for my use just to see if I was capable of doing it after hearing about advancements in athletic shoe technology. During this challenge, I learned the design process of making a shoe, a new way to design in CADD, and the material properties of TPU to accomplish a comfortable shoe. I was more than successful in my endeavor to make shoes. I have grown a lot in my CADD abilities and in my design confidence. I continue to develop the shoes, and I am eager to explore other possibilities opened by the experience of this project.

**Ali Sediqe, Ottawa Hills High School**

***The Effects of Aeration Induced Stress on Zebrafish Learning, Memory, Aggression, and Anxiety***

Oral Presentation: Ruff Memorial Learning Center 07 // 10:30 am



Stress is something everyone faces in life, yet it seems little research has been done into the topic and how it can affect people. Furthermore, the research that has been conducted is introductory and is lacking in depth. Many claim to feel the effects of stress both mentally and physically, yet with the current level of research no clear conclusions can be drawn. I have decided to embark upon this research to add to the current literature in the field and lead us a step closer to reaching a final conclusion to stress and its effects. Zebrafish serve as a perfect research model and using aeration of water is the known best method to stress the fish. A tank tap test, mirror test, and novel tank test was used to test short term memory/learning ability, aggression, and anxiety respectively. We found that stressed fish had significantly worse short term memory and learning capabilities and increased levels of aggression and anxiety compared to non-stressed fish via the aforementioned methods. This research allows us to see a clearer picture of stress and how it can negatively affect us. The next steps that will be taken are a proteomic analysis of the stressed and non-stressed fish to examine how stress affects the fish on a molecular level. Through this initial and future research, we hope to definitively answer the question of the effects of stress on the body.

**Gavin Sheppard, University School**

***Creating a Machine Learning Model to Predict Nick Chubb's Rushing Yards***

Oral Presentation: Ruff Memorial Learning Center 102 // 11:30 am

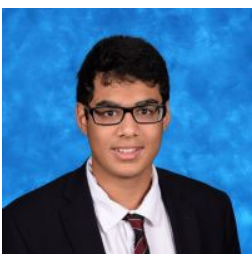


Using statistical analysis in sports was not always seen as useful until Bill James popularized data analysis through Sabermetrics. Sabermetrics used statistical models to find deeper meanings among traditional baseball stats that correlated to player performances. The main objective of this experiment was to create a machine learning model capable of predicting NFL rushing yards. The machine learning model uses supervised learning which has a training dataset consisting of historical football statistics and a testing dataset that defines the parameters of future NFL football games. The model uses attempts, opponent, opponent rushing yards allowed per game, Nick Chubb Madden rating, opponent Madden rating, and broken tackles as factors to determine Nick Chubb's rushing yards. These are organized into datasets with columns for each of the variables and rows for the different games. The final design contained 58 games of training and 16 games of testing from this season. The training data is from Nick Chubb's career prior to the current season, and the testing data is from the games this season. The model was compared against ESPN and number Fire professional models. The model's predictions were closer to the actual rushing yards than ESPN's and number Fire's were 9/16 weeks. Overall, the model had more accurate predictions for Nick Chubb than ESPN and number Fire. This model can be improved by adding more factors to the predictions to make it more accurate and testing it with different players and positions to see how that affects the data.

**Aryan Singh, University School**

***Electric Vehicle Infrastructure Development in the United States***

Poster Presentation: Capital Center Field House // 1:30 pm – 3:00 pm



Transportation is the biggest influence of greenhouse gas emissions, and electric vehicles are the ones that will help solve this problem. The purpose of this project is to determine how many and what kind of chargers (level 2 and DC Fast) will be needed to support the growth of electric vehicles in the US. Electric vehicle penetration in the United States is increasing, but there is a lack of EV infrastructure. There are only 100,968 level 2 chargers and 27,929 DC Fast chargers. Currently there are 4 million electric vehicles in the US, but based on my estimates, there will be more than 25 million electric cars by 2030. There are several factors that will determine the number of charges that will be needed, such as miles traveled commute vs long trip, single vs multi family homes, charger utilization, and energy usage. The miles driven by electric vehicles will increase from 38 billion miles to 341 billion miles, and energy



requirements will increase from 10.9 billion kWh to 97.6 billion kWh by 2030. To support these many electric vehicles on the road, based on the model developed, the United States will need about 255,000 DC Fast and 2.1M level 2 chargers, a significant gap to what exists today. With only 49,597 placed in the United States currently, more chargers will be needed to account for the large increase in electric vehicles on the road. This project will help determine the number of chargers needed to support EV growth in the United States.

**Hans Swain, University School**

***Effect of Excess Dietary Iron on Intestinal Tumorigenesis***

Oral Presentation: Ruff Memorial Learning Center 02 // 10:30 am

Colon cancer is a leading cause of death worldwide. Although essential, excess iron may increase cancer risk. The purpose of this project was to determine the effect of excess dietary iron on intestinal tumorigenesis using immunohistochemistry (IHC) and gene expression data analysis. Previously, Apcmin/+mice were fed three diets: T1 (Control; 45mg Fe/kg diet), T2 (250mg), and T3 (450mg), for 10 weeks (n = 9/treatment). IHC slides of normal and tumor intestinal tissue were imaged (Leica DM 6000 microscope; mag-40X+) to determine percent stained cells expressing Ki-67 – a cellular proliferation marker – and TUNEL apoptotic activity, in 8-10 microvilli (crypt-tip) and equivalent tumor regions/sample. Gene expression data for micro-dissected normal and tumor tissues were analyzed using Mouse Genome 430A 2.0 microarrays. Comparison (t-test) results show significantly different ( $p \leq 0.05$ ) mean Ki-67 stained cells/villi in normal (1.7, 4.4, and 7.2 for T1, T2, and T3) vs. equivalent region tumor tissue (8.4, 16.2, and 20.1 for T1, T2, and T3, respectively), and an approximate 3 to 4-fold increase ( $p \leq 0.05$ ) in apoptosis in T3. Gene expression/pathway data show excess iron altered expression of a variety of genes, more so in tumors, especially genes involved in oxidoreductase (antioxidant) activity, prostaglandin-endoperoxide synthase (COX-2), and glutathione peroxidase, possibly in response to the pro-oxidative, pro-inflammatory effects of excess iron. Key findings are that excess iron accelerates intestinal tumor cell proliferation and alters expression of genes involved in antioxidant status and inflammation. This is clinically significant; long-term, excess iron consumption may accelerate tumor growth, increasing mortality for those susceptible to intestinal cancer.

**Sarah Theewis, Archbishop Alter Highschool**

***The Efficacy of the Disinfection Process, Oxidation, with/out an Added Flocculant***

Oral Presentation: Ruff Memorial Learning Center 103 // 9:30 am

Even in 2023, people around the world die from water sanitation issues. This project was to demonstrate the effectiveness of disinfection process of oxidation, with or without an added flocculate, alum. This study analyzed how effective oxidation was at killing bacteria in landfill water, farmland water, and wastewater. Ammonia, nitrate (NO<sub>3</sub>), nitrite (NO<sub>2</sub>), pH level and bacterial growth were analyzed in 140 water samples; wastewater petri dish results had a mean percent coverage without alum of 26.29% and with alum was 14.25%. The mean landfill percent coverage without alum was 33.22%, while the mean percent coverage with alum was 7.81%. The mean farmland percent coverage without alum was 28.17% and with alum was 21.33%. Chloramines was only tested without alum (the controlled process); the mean percent coverages for wastewater was 35.5%, for the landfill water was 23.61% and for the farmland water was 31.63%. Showing that there was a significant decrease in bacteria when alum was used, and that oxidation was the most effective disinfection process across all processes throughout this study. Oxidation, the indirect photolysis by the breakdown of hydrogen peroxide increased the reaction rate of the production of OH<sup>-</sup> radicals, decreased the amount of bacteria in the water samples.

**Darelle Thornton, Firestone CLC**

***Radical Polymerization of CO<sub>2</sub> via 1,1 Azobis ( Cyclohexane-1-carbonitrile), Zinc Chloride, and Ethylene Carbonate in the Creation of a Novel Renewable and Degradable Plastic***

Poster Presentation: Capital Center Field House // 1:30 pm – 3:00 pm



During 2022 India, Japan, China, and Great Britain emitted 4 million metric tons of CO<sub>2</sub> of which has a direct role in a projected 1.5°C increase in global temperature by 2033. This temperature increase will raise sea levels by 0.66 ft and increase the rate of zoonotic spillovers. As a result, CO<sub>2</sub> has only been used as a monomer in homopolymerization instead of copolymerization which can result in polyethylene alternatives. In response to polymerization bottlenecks impeding copolymerization, my project sought to utilize a novel CO<sub>2</sub>-based monomer as a means of initiating copolymerization with olefins and Lewis acids. During chain propagation, a series of conditions allowed for the formation of reactive conjugated hydrocarbons thereby lowering the energy activation barrier for CO<sub>2</sub> incorporation and overriding the possibility of aliphatic alkene creation. Free energy created via polymer chain propagation, enabled the novel polymeric structure to utilize up to 32% of CO<sub>2</sub> and enable future polyethylene chain incorporation by high regioselectivity. Furthermore, the polymer microstructures were observed by using hydrogen nuclear magnetic resonance analysis. The microstructure mainly consisted of beta units and gamma units due to the addition of a Lewis acid and an azo initiator. Moreover, during DSC analysis, it was also observed that the glassy transition state was within the range of 47-121°C due to the abundance of beta microstructures. The series of results provide evidence that this polymeric material can be utilized as a durable and biodegradable material and can readily replace low and high-density polyethylene products.

**Aaron Velez, University School**

***Effects of Dispersants on Photo-Oxidized vs Fresh Oil Simulated with Olive Oil and Laundry Detergent***

Oral Presentation: Ruff Memorial Learning Center 103 // 11:00 am



The experiment's objective was to find the efficiency of oil dispersants on photo-oxidized oil compared to fresh oil. Oil spills need to be cleaned up effectively to mitigate their detrimental environmental effects. However, the sun alters the oil into compounds that are harder to disperse, and ineffective oil dispersants can harm the environment (Introduction to Dispersants, n.d.). Standardized oil dispersant testing tests fresh oil as opposed to photo-oxidized oil while oil spills start to photo-oxidize after a few hours of sun exposure. When oil is photo-oxidized, bonds are broken, and oxygen attaches (Ward, 2018). The dispersant effectiveness test was determined by simulating an oil spill clean up with olive oil and laundry detergent; detergent efficiency was calculated, with a separatory funnel, to find the amount of dispersed oil. The dispersed oil is mixed with water and detergent and exits the separatory funnel leaving the undispersed oil in the funnel. Dispersants contain detergents, and both are composed of a solvent and a surfactant (Ward, 2018). A study conducted by Colin Ward at the Woods Hole Oceanographic Institution found that oil at the Deepwater Horizon was harder to disperse when it was photo-oxidized. It was hypothesized that the photo-oxidized oil would be harder to disperse compared to fresh oil. Fresh oil had a higher detergent effectiveness than the dispersion of photo-oxidized oil. The data support the hypothesis that photo-oxidized oil is harder to disperse. The experiment's data supports that oil dispersant testing could be improved by testing photo-oxidized oil.

**Margaret Wheeler, Hilltop High School**

***The Strength of Threads and Stitch Types on Cotton Fabric***

Poster Presentation: Capital Center Field House // 1:30 pm – 3:00 pm

The purpose of this experiment was to provide sewers with the necessary information to make an informed decision on what type of thread and stitch to use, in order to hold the seam with the most amount of force. It was hypothesized that cotton thread and a straight stitch would have the greatest seam strength. Nine different stitch and thread combinations: cotton, polyester, and silk thread with a straight, zig-zag, and decorative stitch, with each piece of fabric was 20 by 4 centimeters in length and width. Five samples of each type were then clamped horizontally into the ME-8236 Materials Testing Apparatus,

and pulled apart by the machine until the first stitch snapped. The first hypothesis, about different thread types, was not supported. It was hypothesized that cotton thread would hold the most pounds of force, but it ended up holding the least amount of force. Cotton thread held an average of 21 pounds, while silk thread held an average of 25 pounds, and polyester thread held an average of 31 pounds. The second hypothesis, about different stitch types, was not supported. It was thought that a straight stitch would hold the most amount of force, but it actually held the least amount of force. A straight stitch held an average of 21 pounds, while a decorative stitch held an average of 25 pounds, and a zig-zag stitch held an average of 31 pounds. The best combination was a polyester thread with a zig-zag stitch, and a silk thread with a zig-zag stitch. Polyester thread held significantly more than cotton ( $p = .001$ ) and silk ( $p = .0182$ ). Zig-zag stitch held significantly more than both a straight stitch ( $p < .0001$ ) and a decorative stitch ( $p = .0004$ ).

**Elena Winter, Hathaway Brown School**

***Isocitrate Dehydrogenase 1 Inhibition Sensitizes Melanoma to Temozolomide Chemotherapy***

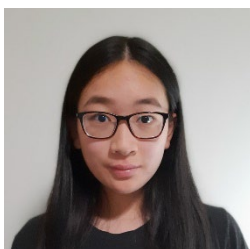
Poster Presentation: Capital Center Field House // 1:30 pm – 3:00 pm

Melanoma is the most deadly form of skin cancer. It is incredibly dangerous in later stages due to its tendency to spread to other areas of the body. The cancer occurs in cells called melanocytes that lie below the epidermis and produce the skin pigment melanin. Historically, the most common form of chemotherapy used to treat melanoma is temozolomide (TMZ), which is a drug that works by damaging DNA. TMZ is often met with resistance from cancer. Ivosidenib (AG-120) is a metabolic inhibitor that targets Isocitrate Dehydrogenase 1 (IDH1). This metabolic enzyme produces the antioxidant NADPH that regulates a toxic waste product in cells called reactive oxygen species (ROS). This dangerous metabolite has the potential to damage DNA. We hypothesized that inhibiting IDH1 could enhance the effectiveness of TMZ when damaging DNA and increase cell death. In this project, we examined the effectiveness of AG-120 to sensitize melanoma cell line A375 to chemotherapy through various invitro clonogenic assays. In addition, we demonstrated that in combination, TMZ and AG-120 were more potent than either drug alone by determining each drug's 50% inhibitory concentration (IC50). Thus, the targeting of the IDH1 enzyme is a potential method to improve the effectiveness of TMZ when treating melanoma.

**Julia Xi, Perrysburg High School**

***A Numerical Study of the Microvirial Theorem with Three-body Gravitational Force Interactions***

Oral Presentation: Ruff Memorial Learning Center 02 // 11:30 am



Motivated by the presence of chaotic and unpredictable motion within the three-body problem due to their mutual gravitational forces, we propose a novel micro-virial theorem that is a special case of the well-known virial theorem. The micro-virial theorem allows the possibility for describing how chaotic motion, which often occurs in  $n$ -body systems, approaches macroequilibrium. It provides a quantitative connection between the macroenergy (kinetic and potential) of the  $n$ -body system and microenergy (kinetic and potential) of individual bodies during chaotic motion. We numerically illustrate the validity of the micro-virial theorem using the motion of three bodies under their respective mutual gravitational forces with various configurations. Our analysis shows that a "micro-component virial theorem" can provide a geometric description of the chaotic motion.

**Anika Yadati, Hathaway Brown School**

***Assessing Skin Biomarkers in Parkinson's Disease***

Oral Presentation: Ruff Memorial Learning Center 06 // 10:30 am

The deposition of misfolded  $\alpha$ -synuclein aggregates in the diseased brain is a molecular hallmark of Parkinson's disease (PD), dementia with Lewy bodies (DLB), and multiple system atrophy (MSA), termed synucleinopathies as a group. A definitive diagnosis depends on the detection of the  $\alpha$ -synuclein-containing Lewy bodies in PD and DLB or glial cytoplasmic inclusions in MSA with patients' brain tissues obtained by biopsy or at autopsy, which is highly invasive or too late. Our recent pioneer study has revealed that the seeding activity of the misfolded  $\alpha$ -synuclein detected in the skin of PD patients by real-time quaking-induced conversion (RT-QuIC) assay could be a novel biomarker for diagnosis of PD (Wang et al., 2020). The purposes

of this study are to optimize the skin-based RT-QuIC assay and to characterize the end-product of skin and brain  $\alpha$ -synuclein RT-QuIC assay. We revealed that the sensitivity of RT-QuIC assay of the pathological  $\alpha$ -synuclein is significantly affected by experimental conditions such as salts and SDS concentrations and  $\alpha$ -synuclein aggregates can be detected in the RT-QuIC end-products of PD skin and brain samples but not in non-PD samples by protease digestion, filter trap assay, sucrose gradient sedimentation and electronic microscopy. We conclude that RT-QuIC seeding assay can represent faithfully seeding activity of the pathological  $\alpha$ -synuclein aggregates in PD.

**Julia Zhu, Hathaway Brown School**

***MFN2, A Potential Therapeutic Target for Alzheimer's Disease***

Oral Presentation: Ruff Memorial Learning Center 201 // 10:00 am



Alzheimer's disease (AD) is the most common age-related neurodegenerative disease that affects memory and learning. Mitochondria are critical to neuronal function in the brain, and brain mitochondrial deficits have long been documented before the clinical onset of AD which suggests that mitochondria dysfunction may play an important role in the pathogenesis of AD. Recent data suggest mitochondrial fragmentation in AD likely underlies impaired mitochondrial homeostasis and function in AD. Among the protein regulators of mitochondrial fusion and fission dynamics, MFN2, a mitochondria fusion protein, is significantly down regulated in the brains of AD patients, which could be the reason of mitochondrial fragmentation in AD. In this study, we investigated whether MFN2 over expression (OE) could rescue mitochondrial deficits in AD and explore whether mitochondrial rescue will alleviate other AD-related deficits. We crossed 5xFAD mice, a widely-used AD mouse model, with MFN2 transgenic mice to generate the double transgenic mice and examined mitochondrial and other AD-related deficits in the double transgenic mice. We found that 5xFAD mice demonstrated fragmented and damaged mitochondria which were rescued by MFN2 OE. MFN2 OE also led to rescue of oxidative stress, neuroinflammation, and neuronal loss in 5xFAD mice. Using M17 human neuroblastoma cells, We further demonstrated that teriflunomide, a FDA-approved drug that induces MFN2.

**Michael Zhu, University School**

***Surface Engineering of Bioplastics***

Oral Presentation: Ruff Memorial Learning Center 201 // 11:00 am



Bioplastics have been an area of interest for a few decades, since they are for the most part more environmentally friendly than petrochemical-based plastics. It is necessary to replace them, but is hard to perform, as surface engineering of biodegradable plastics is difficult, which this investigation explores. The question tested was "Is it possible to tailor the surface properties of biodegradable plastics by adding hydrophilic or hydrophobic additives?" The hypothesis predicted that it was possible to tailor the surface properties by adding hydrophilic or hydrophobic additives, which would make the plastic more hydrophilic or hydrophobic correspondingly. The materials used were cornstarch, potato starch, rice starch, agar agar, paraffin wax, EBS wax, Polysorbate 80, water, glycerol, a weighing scale, a pot, a stove, chopsticks, an oven, petri dishes, a cup, a measuring cup, a dropper, an iPhone, and a hot press. The procedure used was to create samples of bioplastic from the corn, potato, agar, and rice starch, then press them with a hot press, then drop water on them, then measure the contact angle using an iPhone. The most accurate measurement would then be recorded. The hypothesis was supported. It was possible to tailor the surface properties of bioplastics and make them more hydrophilic and hydrophobic. By being able to tailor the surface properties, this results in an expanded usage in the bioplastic industry, as it is more compatible with packaging, health care and other industries that require different surface properties, which decreases pollution as bioplastics are environmentally friendly.

JUDGING CRITERIA

**Oral Presentation Scoring Rubric**

The Ohio JSHS recognizes students for original research achievements in the sciences, technology, engineering, or mathematics (STEM). The overall requirement for a paper presentation is that students demonstrate valid investigation and experimentation aimed at discovery of knowledge. The judging criteria and scoring for the Ohio JSHS are presented in the following chart. This scale has a total score of 30 points and serves as the basis for discussions among the judging team. The decisions of the judging team are final.

Judging Criteria:	Fair	Satisfactory	Good	Excellent	Superior
<b>STATEMENT AND IDENTIFICATION OF RESEARCH PROBLEM</b> <ul style="list-style-type: none"> <li>Is the problem clearly stated?</li> <li>Does the presenter demonstrate understanding of existing knowledge about the research problem?</li> </ul>					
<b>SCIENTIFIC THOUGHT, CREATIVITY/ORIGINALITY</b> <ul style="list-style-type: none"> <li>Process skills demonstrated by the student in the solution to the research problem and/or the research design</li> <li>Student demonstrates his or her individual contributions to and understanding of the research problem</li> <li>Level of effort</li> </ul>					
<b>RESEARCH DESIGN, PROCEDURES (MATERIALS &amp; METHODS), RESULTS</b> <p>Science</p> <ul style="list-style-type: none"> <li>Appropriateness of research design and procedures Identification and control of variables Reproducibility</li> </ul> <p>Engineering, Computer Science, Technology</p> <ul style="list-style-type: none"> <li>Workable solution that is acceptable to a potential user</li> <li>Recognition of economic feasibility of solution</li> <li>Recognition of relationship between design and end product</li> <li>Tested for performance under conditions of use</li> <li>Results offer an improvement over previous alternatives</li> </ul>					
<b>DISCUSSION/CONCLUSIONS</b> <ul style="list-style-type: none"> <li>Clarity in stating conclusion</li> <li>Logical conclusion that is relevant to the research problem and the results of experimentation or testing</li> <li>Recognizes limits and significance of results</li> <li>Evidence of student’s understanding of the scientific or technological principles</li> <li>Theoretical or practical implications recognized</li> <li>What was learned?</li> </ul>					
<b>SKILL IN COMMUNICATING RESEARCH RESULTS – ORAL PRESENTATION AND WRITTEN REPORT</b> <ul style="list-style-type: none"> <li>Clarity in communicating research results to non-specialized audience and to judges</li> <li>Definition of terms as necessary</li> <li>Appropriate use of audio-visuals Response to questions from audience and judges</li> </ul>					
<b>ACKNOWLEDGMENT OF SOURCES AND MAJOR ASSISTANCE RECEIVED</b>					

Poster Presentation Scoring Rubric

Scoring Category	1 Needs Improvement	2 Acceptable	3 Good	4 Excellent
Appearance/Clarity	The poster is difficult to understand, and/or lacks important information or has excessive and superfluous information.	Organization and appearance of the poster is adequate but could be improved; some sections are significantly deficient of excessive.	Poster is logically organized; use of headings, fonts, etc. is good; some text is overly lengthy and/or contains errors.	Poster is logically organized; effectively uses headings, fonts, colors and white space; text is concise and error-free.
Abstract	Abstract does not represent student's research or is seriously deficient in terms of accuracy, completeness, clarity, and conciseness.	Abstract is adequate, but has significant deficiency in accuracy, completeness, clarity, and/or conciseness.	Abstract mostly represents student's research, but is slightly deficient in accuracy, completeness, clarity, or conciseness.	Abstract accurately represents the student's research, clearly and accurately summarizes the project and is complete and concise.
Research Questions	Research questions are unclear and not aligned to the purpose of the study.	Research questions are adequately defined but have significant lack of clarity or alignment with the purpose of the study.	Research questions are well defined but have slight lack of clarity or alignment with the purpose of the study.	Research questions are very clearly defined and well aligned with the purpose of the study.
Significance of the Research	Explanation of the research problem and its connection to broader issues is largely deficient.	Explanation of the research problem and its connection to broader issues is significantly deficient but has some good points.	Explanation of the research problem and its connection to broader issues has minor deficiencies or is slightly weak.	Student clearly explains the research problem being addressed by the study; clear connections are made to broader issues.
Research Methods	Methods are not appropriate for the purpose of the study or the description is seriously deficient.	Methods are somewhat appropriate and/or the description has some significant deficiencies.	Methods are largely well chosen and well described but there are some slight deficiencies.	Methods creatively and effectively support the purpose of the study and the description is complete, easy to understand, and concise.
Conclusions	Unreasonable conclusions are provided and/or no supporting evidence is provided.	Conclusions are appropriate but there are significant deficiencies in evidence or reasoning.	Conclusions are reasonable and supported by evidence but there are slight deficiencies.	All appropriate conclusions are cited and well justified by evidence, reasoning is sound and complete.
Limitations	Student identification of limitations is largely lacking or deficient.	Student identification and explanation of limitations has significant deficiencies.	Student identification and explanation of limitations has slight deficiencies.	Student clearly and completely identifies and explains all limitations in the study.
Graphs and/or Tables	Graphs and/or tables are largely deficient with major flaws or omissions.	Graphs and/or tables have significant deficiencies in organization, completeness, or appropriateness.	Graphs and/or tables have slight deficiencies in organization, completeness, accuracy, or appropriateness.	Graphs and/or tables are appropriate, well organized, complete, and accurate.
Knowledge of Project/Handling of Questions	Student demonstrates little or incorrect knowledge of project when answering questions.	There are significant deficiencies in the student's knowledge of the project when answering questions.	There are slight deficiencies in the student's knowledge of the project when answering questions.	Student is very knowledgeable about the project; effectively handles difficult questions.
Presence	Student interacts poorly, unprofessionally, or inappropriately with the judge.	Student speaking and interacting with the judge is adequate but lacks some clarity, confidence, and poise.	Student is professional with only slight deficiencies in clarity, confidence, or poise.	Student is professional and displays excellent enthusiasm, confidence, and poise.

## AWARDS

**Student Awards****1st Place Winner**

**\$2,000 College Scholarship sponsored by the United States Army, Navy, and Air Force**

Presents research paper at the 2023 National JSHS held April 12-15, 2023

**2nd Place Winner**

**\$1,500 College Scholarship sponsored by the United States Army, Navy, and Air Force**

Presents research paper at the 2023 National JSHS held April 12-15, 2023

*The 1st and 2nd place winners have an opportunity to win the following awards at the National JSHS:*

- Six \$12,000 undergraduate tuition scholarships, awarded to each of the 1st place finalists in the National research paper competition
- Six \$8,000 undergraduate tuition scholarships, awarded to each of the 2nd place finalists in the National research paper competition
- Six \$4,000 undergraduate tuition scholarships, awarded to each of the 3rd place finalists in the National research paper competition

**3rd Place Winner**

**\$1,000 College Scholarship sponsored by the United States Army, Navy, and Air Force**

Presents poster at the 2023 National JSHS held April 12-15, 2023

**4th Place Winner**

Presents poster at the 2023 National JSHS held April 12-15, 2023

**5th Place Winner**

Presents poster at the 2023 National JSHS held April 12-15, 2023

**Ohio JSHS Award for Best Poster Presentation**

Certificate for Best Poster Presentation

## Congratulations to the 2022 Winners!

### 1st Place Winner **Mihai Crisan, Upper Arlington High School**

\$2,000 College Scholarship sponsored by the United States Army, Navy, and Air Force // Presented paper at the 2022 National JSHS

### 2nd Place Winner **Amelia Campbell, Tippecanoe High School**

\$1,500 Ohio JSHS College Scholarship sponsored by the United States Army, Navy, and Air Force // Presented paper at the 2022 National JSHS

### 3rd Place Winner **Kaitlyn Greppin, Hathaway Brown School**

\$1000 Ohio JSHS College Scholarship sponsored by the United States Army, Navy, and Air Force // Presented poster as 2022 National JSHS

### 4th Place Winner **Laasya Acharya, William Mason High School**

Presented poster at the 2022 National JSHS

### 5th Place Winner **Justice Arai, University School**

Presented poster at the 2022 National JSHS

## Cumulative Record of the Ohio Student Paper Presenters to the National JSHS

YEAR	NAME	SCHOOL
2022	Mihai Crisan	Upper Arlington High School
	Amelia Campbell	Tippecanoe High School
2021	Kaisal Shah	Hathaway Brown School
	Laalitya Acharya	William Mason High School
2020	Aditi Kumari	Olentangy High School
	Anya Razmi	Hathaway Brown High School
2019	Hannah Doris	Sylvania Northview High School
	Garret Blum	University School
2018	Arukshita Goel	Sylvania Southview High School
	Suraj Srinivasan	Strongsville HS
2017	Arman Serpen	Sylvania Southview High School
	Srinath Seshardi	Village Academy, Powell
2016	Graham Lane	University School
	Rama Balasubramaniam	Dublin Coffman High School
2015	Pallavi Lanka	Sylvania Southview High School
	Srinath Seshardi	Village Academy, Powell
2014	Bluyé DeMessie	William Mason High School
	Aditya Jog	William Mason High School
2013	Bluyé DeMessie	William Mason High School
	Peeyush Shrivastava	William Mason High School



## The Colonel George F. Leist Distinguished Teacher Award

Each year, an Ohio teacher is selected to receive The Colonel George F. Leist Distinguished Teacher Award. The United States Army, Navy, and Air Force sponsor this award of \$500 to purchase books, supplies, and equipment for the school. The recent history of award winners is listed below.

### 2023 Awardee: Rachel Sanders, Global Impact STEM Academy in Springfield



Rachel Sanders is the bioresearch instructor at Global Impact STEM Academy located in the city of Springfield. Ms. Sanders inspires students to challenge the rules and take risks, to demonstrate how to be collaborative and empathetic, and see the value of learning from failure and staying curious. For over 20 years she has served as the Coordinator for the Clark County Science & Engineering Fair affiliated with the Ohio Academy of Science and Advocate for Ohio with the Society for Science and Public which provides students in grades 5-12 with assistance in conducting research from the local level to the international level. She also served as the high school educator representative for the Clark County Food Summit with Ohio State University Extension and content creator for the Bioenergy and Bioproducts Summit for OBIC (Ohio Biological Innovation Center) in conjunction with Cornell University. Throughout the summers, Ms. Sanders is an active teacher leader with USDA/NIFA Science of Food and Fuel Committee, Grown Next Gen, Field to Package, Feed the World, and Nourish the Future organizations, conducting workshops with over 400 science and agricultural educators from across the nation demonstrating how agriculture is a viable vehicle for teaching STEM.

Throughout the summers, Ms. Sanders is an active teacher leader with USDA/NIFA Science of Food and Fuel Committee, Grown Next Gen, Field to Package, Feed the World, and Nourish the Future organizations, conducting workshops with over 400 science and agricultural educators from across the nation demonstrating how agriculture is a viable vehicle for teaching STEM.

### Cumulative Record of the Colonel George F. Leist Distinguished Teacher Award

Year	Name	School
2022	Crystal Miller	Hathaway Brown School
2021	Crystal Miller	Hathaway Brown School
2020	Jeremy Nixon	Ottawa Hills High School
2019	Kathryn Nelson	Sylvania Northview High School
2018	Sara Laux	University School
2017	Tyler Bruns Rebekah Rice	Gahanna Lincoln High School Gahanna Lincoln High School
2016	Deborah Bogard	Delaware City Schools
2015	Matt Wallschlaeger	Big Walnut High School
2014	Blythe Tipping	Sylvania Southview High School
2013	Abbie Smith	Hilltop Junior High School
2012	Fred Donelson	Gahanna Lincoln High School
2011	Robert Sudomir	Louisville High School

ACKNOWLEDGEMENTS

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SYMPOSIUM EVALUATION

Please, remember to complete the online evaluation for the 2023 Ohio Junior Science & Humanities Symposium (JSHS). Your input is highly valued and necessary for the continuing success of the Ohio JSHS.

You will receive an email reminding you to take the survey. Thank you in advance for your cooperation!

Thank you so much for your participation in the evaluation of JSHS!